



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
WASHINGTON, D.C. 20460

OFFICE OF CHEMICAL SAFETY  
AND POLLUTION PREVENTION

**MEMORANDUM**

**Date** 14-November-2012

**Subject:** **Glyphosate.** Section 3 Registration Concerning the Application of Glyphosate to Carrots, Sweet Potato, Teff, and Oilseeds (Crop Group (CG) 20) and to Update the CG Definitions for Bulb Vegetable (CG 3-07), Fruiting Vegetable (CG 8-10), Citrus Fruit (CG 10-10), Pome Fruit (CG 11-10), and Berry (CG 13-07).  
Summary of Analytical Chemistry and Residue Data.

PC Codes: 417300, 103601, 103613	DP Barcode: D398861
Decision No.: 459870	Registration Nos.: 524-475; 524-537
Petition No.: 2E7979	Regulatory Action: Section 3
Risk Assessment Type: not applicable	Case No.: 178
TXR No.: not applicable	CAS No.: 1071-83-6
MRID No.: 48720101 and 48720102	40 CFR: 180.364

**From:** Tom Bloem, Chemist *[Signature]*  
Risk Assessment Branch 1/Health Effects Division (RAB1/HED; 7509P)

**Through:** George F. Kramer, Ph.D., Senior Chemist  
RAB1/HED (7509P) *[Signature]* 11/20/12

**To:** Barbara Madden and Andrew Ertman RM 05  
Registration Division (RD; 7505P)

The Interregional Research Project No. 4 (IR-4) requested a Section 3 Registration modifying the currently registered application scenario for carrot, sweet potato, and the oilseeds (CG 20). IR-4 also proposed translation of the wheat forage/hay tolerance to teff forage/hay and proposed updating the crop group (CG) definitions for bulb vegetable (crop group (CG) 3-07), fruiting vegetable (CG 8-10), citrus fruit (CG 10-10), pome fruit (CG 11-10), and berry (CG 13-07).

## Executive Summary

**Background:** Glyphosate is a nonselective Group 9 herbicide that disrupts the synthesis of the aromatic amino acids tyrosine, tryptophan, and phenylalanine through inhibition of 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS). Glyphosate is currently registered for pre- and post-emergence application to a variety of fruit, vegetable, and field crops. Tolerances are currently established for residues of glyphosate in/on various plant commodities at 0.2-400 ppm (40 CFR §180.364(a)(1)) and for the combined residues of glyphosate and *N*-acetyl-glyphosate (expressed in glyphosate equivalents) in/on field corn, soybean, canola, aspirated grain fractions (AGF), and livestock commodities at 0.10-310 ppm (40 CFR §180.364(a)(2)). The glyphosate Reregistration Eligibility Decision (RED) document was issued September 1993. A Registration Review Scoping document was completed in 2009 (D362745, J. Langsdale *et al.*, 3-Jun-2009).

The current proposal concerns application of glyphosate to carrots, sweet potato, teff, and the oilseeds (CG 20). The petitioner is also proposing to update the CG definitions for bulb vegetable (CG 3-07), fruiting vegetable (CG 8-10), citrus fruit (CG 10-10), pome fruit (CG 11-10), and berry (CG 13-07). As a result of these proposals, the tolerances listed in Table 8 for residues of glyphosate *per se* are proposed.

**Proposed Use:** The petitioner submitted proposed supplemental labels for Roundup Ultra® and Roundup WeatherMAX® concerning wiper application to carrot and sweet potato and harvest-aid application to all oilseed crops (currently harvest-aid application is only permitted for the following oilseed crops: cotton, safflower, and sunflower). The petitioner also updated these labels to reflect the most recent commodity definitions for the following CGs: bulb vegetables CG 3-07; fruiting vegetables CG 8-09; citrus fruit CG 10-09; pome fruit CG 11-09; stone fruit CG 12-10; and berry CG 13-07. Table 4 is a summary of the proposed end-use products and Table 5 is a summary of the proposed application scenarios.

HED concludes that the proposed labels are adequate provided the following are addressed (revised Section B is requested): (1) oilseeds CG 20 - both the Roundup Ultra® and Roundup WeatherMAX® labels should indicate that only a single harvest-aid application is permitted and should indicate that for canola, the harvest-aid application pertains to only those varieties which are not tolerant to glyphosate; (2) bulb vegetables CG 3-07 - the Roundup Ultra® and Roundup WeatherMAX® supplemental labels concerning application to bulb vegetables include statements concerning application to nonbearing ginseng and rutabaga which should be removed; (3) pome fruit CG 11-09 - the Roundup Ultra® and Roundup WeatherMAX® supplemental labels concerning application to pome fruit include statements concerning application to berries, citrus, and tree nuts which should be removed; and (4) berry and small fruit crop group 13-07 - in order to conform with the current strawberry (representative crop for subgroup 13-07G) label instructions, both the Roundup Ultra® and Roundup WeatherMAX® labels should be revised to indicate a maximum yearly application rate to subgroup 13-07G crops of 6.0 lb ae/acre and should indicate a 30-day PBI (plantback interval) for all nonlabeled crops following application to 13-07G crops (excluding cranberry).

**Nature of the Residue - Primary Crops:** Metabolism studies conducted with non-transgenic corn, cotton, soybeans, and wheat were previously submitted and reviewed. Based on these data, HED concluded that the residue of concern in non-transgenic plants is glyphosate (Memo, R. Perfetti, 19-Oct-1992; RED, R. Perfetti, 27-Oct-1992; Memo, R. Perfetti, 17-Mar-1994). Metabolism studies have also been submitted on glyphosate-tolerant canola (RT73; D242628, T. Bloem, 30-Nov-1998) and glyphosate-tolerant field corn (Roundup Ready® field corn; D217539, G. Kramer, 14-Mar-1996). The glyphosate-tolerant canola and field corn varieties were genetically modified to express the EPSPS gene derived from *Agrobacterium sp.* (strain CP4) which codes for an EPSPS protein that is not inhibited by glyphosate. The glyphosate-tolerant canola and corn were also genetically engineered to express the oxireductase gene which converts glyphosate to the non-herbicidal AMPA (aminomethyl phosphonic acid). Metabolism in these varieties of transgenic canola and corn was essentially the same as the non-transgenic plants. Therefore, it was concluded that the terminal residue to be regulated, in non-transgenic plants and transgenic field corn and canola modified to express the *Agrobacterium sp.* EPSPS and oxireductase genes, is glyphosate.

Subsequent to these decisions, HED approved DuPont requests permitting the commercialization of Optimum™ GAT™ soybean, Optimum™ GAT™ field corn, and Optimum® GLY Canola. These soybean, field corn, canola varieties were genetically engineered to express the *gat4601* or *gat4621* genes (derived from *Bacillus licheniformis*; soil bacterium) which confer tolerance to glyphosate via conversion of parent to the non-herbicidal *N*-acetyl-glyphosate. The Optimum™ GAT™ field corn was also engineered to express the *zm-hra* gene (modified version of maize acetolactate synthase (ALS) gene) which encodes for an ALS protein which is not sensitive to the ALS-inhibiting herbicides. As a result of the introduction of these seed lines, HED concluded that the residues of concern in soybean, field corn, and canola for tolerance expression and risk assessment should change from glyphosate to the combined residues of glyphosate and *N*-acetyl-glyphosate (expressed in glyphosate equivalents; D346713, T. Bloem, 12-Mar-2008; D357880, T. Bloem, 29-Oct-2008; D361315, T. Bloem, 14-Jan-2010; D394964, T. Bloem, 15-Nov-2011).

**Nature of the Residue - Livestock:** The qualitative nature of the residue in livestock following dosing with glyphosate and AMPA is adequately understood. Studies with lactating goats and laying hens fed a mixture of glyphosate and AMPA indicate that the primary route of elimination was by excretion (urine and feces). HED determined that the terminal residue to be regulated in livestock is glyphosate (Memo, R. Perfetti, 19-Oct-1992; RED, R. Perfetti, 27-Oct-1992; Memo, R. Perfetti, 17-Mar-1994). DuPont previously submitted summaries of *in vitro* (rumen fluid, fertile hen egg, and rat liver S9 supernatant) and *in vivo* (rat, goat, and hen metabolism studies) studies conducted with the *N*-acetyl-glyphosate metabolite. Based on these data and the glyphosate metabolism studies, HED concluded that the residues of concern in livestock following consumption of glyphosate and *N*-acetyl-glyphosate, for tolerance expression and risk assessment purposes, are glyphosate and *N*-acetyl-glyphosate (expressed in glyphosate equivalents; D346713, T. Bloem, 12-Mar-2008; D361315, T. Bloem, 14-Jan-2010).

**Magnitude of the Residue - Proposed Primary Crops:** Provided a revised Section B is submitted, HED concludes that the proposal to update the commodity members for the following CGs to reflect current HED policy is acceptable and the tolerances from the old CGs may be translated to the new CGs: bulb vegetables CG 3-07; fruiting vegetables CG 8-09; citrus fruit CG 10-09; pome fruit CG 11-09; stone fruit CG 12-10; and berry CG 13-07. In addition, the

petitioner proposed the translation of the 100-ppm cereal grain CG 16 (except field corn forage/stover) tolerance to teff forage and hay. Based on similar morphological, cultural practices, taxonomical characteristics, and application scenarios for teff and the small grains, HED concludes that this translation is acceptable (Chemistry Science Advisory Council (ChemSAC); min\_542.02-May-2012).

The petitioner is also proposing the expansion of the carrot and sweet potato application scenario to include-over-the-top wiper application and submitted adequate carrot and sweet potato magnitude of the residue data depicting this application scenario. Based on these data and the Organization of Economic Cooperation and Development (OECD) tolerance calculation procedure, HED concludes that the carrot and sweet potato tolerances listed in Table 1 are appropriate. A revised Section F is requested.

Finally, the petitioner is proposing the establishment of an oilseed CG 20 tolerance (40 ppm; glyphosate only) and is proposing harvest-aid application to all CG 20 crops. The representative crops for CG 20 are canola (subgroup 20A), sunflower (subgroup 20B), and cotton (subgroup 20C) with glyphosate tolerances established in/on the seeds of these crops as follows: canola seed - 20 ppm (combined glyphosate and *N*-acetyl-glyphosate), sunflower/safflower seed - 85 ppm (glyphosate only), and cotton seed - 40 ppm (glyphosate only). Tolerances are also established in/on several other CG 20 crops as follows: borage - 0.1 ppm, crambe - 0.1 ppm, flax - 4.0 ppm, meadowfoam - 0.1 ppm, mustard - 0.1 ppm, safflower - 85 ppm, and sesame - 0.1 ppm. These tolerances reflect preemergent and postemergent (row middles using shielded sprayers or wiper equipment) application for all as well as harvest-aid application for sunflower (0.77 lb ae/acre), safflower (2.25 lb ae/acre), and cotton (1.55 lb ae/acre) and over-the-top application to canola and cotton (glyphosate-tolerant varieties).

Based on reevaluation of the sunflower/safflower seed harvest-aid data using the OECD tolerance calculation procedure and in order to maintain harmonization with the currently-established Canadian (canola seed) and Codex (cotton seed and canola seed) tolerances, HED concludes that the oilseed tolerances listed in Table 1 are appropriate.

**Magnitude of the Residue - Livestock:** HED concludes that for the following reasons the proposals associated with the current petition will not have a significant effect on the livestock dietary burdens and the currently-established livestock tolerances remain appropriate: (1) the additional crops included in the updated CG definitions are not considered significant feed commodities; (2) the proposal to extend the harvest-aid application scenario to all oil seed crops (CG20) will not have a significant effect on the livestock dietary burdens as harvest-aid application to cotton, sunflower, and safflower is currently registered; and (3) the increase in the carrot (carbohydrate concentrate (CC)) tolerance to will not have a significant impact on the livestock dietary burdens as a 30-ppm tolerance in/on the grain of several small grains (CC) is currently established.

**Nature/Magnitude of the Residue - Rotational Crops:** HED previously concluded that a 30-day PBI was appropriate for all non-labeled crops (D200041, G. Kramer, 12-May-1994). Provided a revised Section B is submitted specifying a 30-day PBI for all non-labeled crops following application to 13-07G crops (excluding cranberry), the proposed labels will conform with this requirement.

**Analytical Enforcement Method:** Glyphosate is currently registered for application to a wide variety of crops and HED concludes the currently-available tolerance enforcement method is suitable for enforcement of the tolerances recommended here.

**Recommendations:** Provided the petitioner submits revised Sections B and F, HED concludes that the residue chemistry database supports an unconditional registration and establishment of the tolerances listed in Table 1 for residues of glyphosate *per se* (40 CFR §180.364(a)(1)). A human-health risk assessment will be prepared as a separate document (D387535).

With the establishment of the tolerances listed in Table 1, the following tolerances should be deleted: vegetables, root and tuber, crop group 1, except sugar beet; vegetable, bulb, group 3; vegetable, fruiting, group 8; fruit, citrus, group 10; fruit, pome, group 11; berry group 13; borage, seed; cotton, undelinted seed; crambe, seed; flax, meal; flax, seed; jojoba seed; lesquerella, seed; meadowfoam, seed; mustard seed; rapeseed, seed; safflower, seed; sesame, seed; sunflower, seed; cranberry; grape; juneberry; kiwifruit; lingonberry; salal; and strawberry.

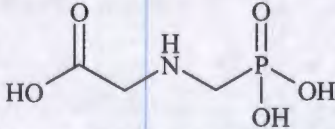
**Table 1: Tolerance Summary.**

Commodity	HED-Recommended Tolerance (ppm)
vegetables, root and tuber, group 1, except carrot, sweet potato, and sugar beet	0.20
carrot	5.0
sweet potato	3.0
oilseeds, group 20, except canola	40
vegetable, bulb, group 3-07	0.20
vegetable, fruiting, group 8-10 (except okra)	0.10
fruit, citrus, group 10-10	0.50
fruit, pome, group 11-10	0.20
berry and small fruit, group 13-07	0.20
teff, forage	100
teff, hay	100

## Background

Glyphosate is a nonselective Group 9 herbicide which disrupts the synthesis of the aromatic amino acids tyrosine, tryptophan, and phenylalanine through inhibition of EPSPS. Glyphosate is currently registered for pre- and post-emergence application to a variety of fruit, vegetable, and field crops. Tolerances are currently established for residues of glyphosate in/on various plant commodities at 0.2-400 ppm (40 CFR §180.364(a)(1)) and for the combined residues of glyphosate and *N*-acetyl-glyphosate (expressed in glyphosate equivalents) in/on field corn, soybean, canola, AGF, and livestock commodities at 0.1-310 ppm (40 CFR §180.364(a)(2)). The glyphosate RED document was issued September 1993. A Registration Review Scoping document was completed in 2009 (D362745, J. Langsdale *et al.*, 3-Jun-2009). The chemical structure/nomenclature and physicochemical properties of glyphosate are presented in Tables 2 and 3, respectively.

**Table 2: Glyphosate Nomenclature.**

Compound	
Common name	Glyphosate (PC code 471300)
Company experimental name	DPX-B2856
IUPAC/CAS name	<i>N</i> -(phosphonomethyl)glycine
CAS registry number	1071-83-6

**Table 3: Physicochemical Properties of Technical Grade Glyphosate.**

Melting point	189.5 ± 0.5 °C	The Pesticide Manual, 13 <sup>th</sup> Edition
pH	1.9 at 20 °C	
Density	1.705 g/cm <sup>3</sup> at 20 °C	
Water solubility	10.5 g/L at 20 °C	
Solvent solubility	acetone 0.078 g/L methanol 0.231 g/L hexane 0.026 g/L ethyl acetate 0.012 g/L dichloromethane 0.233 g/L n-octanol 0.020 g/L propan-2-ol 0.020 g/L toluene 0.036 g/L	European Commission: Glyphosate 6511/VI/99-final, 1/21/02
Vapor pressure	1.31 x 10 <sup>-2</sup> mPa at 25 °C	The Pesticide Manual, 13 <sup>th</sup> Edition
Dissociation constant, pK <sub>a</sub>	0.8 (1 <sup>st</sup> phosphoric), 2.3 (carboxylate), 6.0 (2 <sup>nd</sup> phosphoric), and 11.0 (amine)	Knuuttila. 1979 Acta Chem. Scand. B 33:623-626
Octanol/water partition coefficient, Log(K <sub>OW</sub> )	-3.2 (pH 2-5, 25 °C)	European Commission: Glyphosate 6511/VI/99-final, 1/21/02
UV/visible absorption spectrum	ε = 0.086 (295nm)	

**860.1200 Directions for Use**

The petitioner submitted proposed supplemental labels for Roundup Ultra® and Roundup WeatherMAX® concerning wiper application to carrot and sweet potato and harvest-aid application to all oilseed crops (currently harvest-aid application is only permitted for the following oilseed crops: cotton, safflower, and sunflower). The petitioner also updated these labels to reflect the most recent commodity definitions for the following CGs: bulb vegetables CG 3-07; fruiting vegetables CG 8-09; citrus fruit CG 10-09; pome fruit CG 11-09; stone fruit CG 12-10; and berry CG 13-07. Table 4 is a summary of the proposed end-use products and Table 5 is a summary of the proposed application scenarios.

HED concludes that the proposed labels are adequate provided the following are addressed (revised Section B is requested): (1) oilseeds CG 20 - both the Roundup Ultra® and Roundup WeatherMAX® labels should indicate that only a single harvest-aid application is permitted and should indicate that for canola, the harvest-aid application pertains to only those varieties which are not tolerant to glyphosate; (2) bulb vegetables CG 3-07 - the Roundup Ultra® and Roundup WeatherMAX® supplemental labels concerning application to bulb vegetables include statements concerning application to nonbearing ginseng and rutabaga which should be removed; (3) pome fruit CG 11-09 - the Roundup Ultra® and Roundup WeatherMAX® supplemental labels concerning application to pome fruit include statements concerning application to berries, citrus, and tree nuts which should be removed; and (4) berry and small fruit crop group 13-07 - in order to conform with the current strawberry (representative crop for subgroup 13-07G) label instructions, both the Roundup Ultra® and Roundup WeatherMAX® labels should be revised to indicate a maximum yearly application rate to subgroup 13-07G crops of 6.0 lb ae/acre and should indicate a 30-day PBI for all nonlabeled crops following application to 13-07G crops (excluding cranberry).

**Table 4: Summary of Proposed End-Use Products.**

Trade Name	EPA Reg. No.	concentration	Form.	Label Date	Target Crops	Target Pests
Roundup Ultra®	524-475	glyphosate as the isopropylamine salt; 4 lbs ai/gallon; 3 lbs ae/gallon	water-soluble liquid	not provided	root and tuber vegetables (CG 1) bulb vegetable crops (CG 3-07) fruiting vegetables (CG 8-10) citrus (CG 10-10) pome fruits (CG 11-10) berry (CG 13-07) oilseed crops (CG 20)	numerous annual and perennial grasses and broadleaf weeds
Roundup WeatherMAX®	524-537	glyphosate as the potassium salt; 5.5 lbs ai/gallon; 4.5 lbs ae/gallon	water-soluble liquid	not provided	carrot sweet potato root and tuber vegetables (CG 1) bulb vegetable crops (CG 3-07) fruiting vegetables (CG 8-10) citrus (CG 10-10) pome fruits (CG 11-10) berry (CG 13-07) oilseed crops (CG 20)	

**Table 5: Summary of Proposed Directions for Use.**

App. Timing, Type, and Equip.	Formulation (EPA Reg. No.)	App. Rate (lb ae/acre)	Max. No. App. per Season	Max. Seasonal App. Rate (lb ai/acre)	PHI (days)	Use Directions and Limitations
carrot						
post-emergent; wiper or sponge bar applicators	Roundup WeatherMAX® (EPA Reg. No. 524-537)	--	2	--	7	<ul style="list-style-type: none"> <li>-Applications are to be made with a 33% solution of the formulated product (by volume).</li> <li>-The first application can be made 60 days before harvest and the second application made 7 days before harvest.</li> <li>-Wiper contact should be a minimum of 2 inches above the desirable vegetation.</li> <li>-Weeds should be 6 inches above the desirable vegetation.</li> <li>-Applicators should be operated at a ground speed of no greater than 5 miles per hour.</li> <li>-Better results may be made when two applications are made in opposite directions.</li> <li>-Do not add a surfactant to the solution when using a wiper applicator.</li> </ul>
sweet potato						
post-emergent; wiper or sponge bar applicators	Roundup WeatherMAX® (EPA Reg. No. 524-537)	--	5	--	7	<ul style="list-style-type: none"> <li>-Applications are to be made with a 33% solution of the formulated product (by volume).</li> <li>-RTI (retreatment interval) of 14 days.</li> <li>-Wiper contact should be a minimum of 2 inches above the desirable vegetation.</li> <li>-Weeds should be 6 inches above the desirable vegetation.</li> <li>-Applicators should be operated at a ground speed of no greater than 5 miles per hour.</li> <li>-Better results may be made when two applications are made in opposite directions.</li> <li>-Do not add a surfactant to the solution when using a wiper applicator.</li> </ul>
oilseed crops (CG 20) <sup>1</sup> : Borage; calendula; castor oil plant; Chinese tallow tree; crambe; cuphea; echium; euphorbia; evening primrose; flax seed; gold of pleasure; hare's ear mustard; jojoba; lesquerella; lunaria; meadowfoam; milkweed; mustard seed; niger seed; oil radish; poppy seed; rapeseed (canola varieties); rose hip; safflower; sesame; stokes aster; sunflower; sweet rocket; tallowwood; tea oil plant; vernonia; and cultivars, varieties, and/or hybrids of these.						
preharvest harvest-aid application; broadcast spray; ground and aerial application <sup>1</sup>	Roundup WeatherMAX® (EPA Reg. No. 524-537) Roundup Ultra® (EPA Reg. No. 524-475)	safflower - 2.25 <sup>1</sup> sunflower - 0.77 <sup>1</sup> cotton - 1.55 <sup>1</sup> all others - 1.12 <sup>1</sup>	not indicated	see "Use Direction and Limitations" column	7	<ul style="list-style-type: none"> <li>-Use sufficient water volume to ensure thorough coverage of foliage (3-40 GPA for ground and 3-15 GPA for aerial).</li> <li>-If no harvest-aid application is made, then the maximum seasonal application rate is 6.0 lbs ae/acre. If a harvest-aid application is made, then the following maximum seasonal application rates apply: safflower - 4.50 lbs ae/acre (2.25 lbs ae/acre as harvest aid); sunflower - 1.54 lbs ae/acre (0.77 lbs ae/acre as harvest aid); cotton - 6.0 lbs ae/acre (1.55 lbs ae/acre as harvest aid); and all others - 2.62 lbs ae/acre (1.12 lbs ae/acre as harvest aid).</li> </ul>

<sup>1</sup> Preplant, at-planting, pre-emergence, and post-emergence (application to row middles) application are currently permitted for oilseed crops and harvest-aid application to cotton, sunflower, and safflower are also currently permitted. The proposed use is to allow harvest-aid application to all oilseed crops (CG 20; except Buffalo gourd). Since the difference for the proposed use and the registered use concerns only harvest-aid application, only the application rate for harvest-aid application are included in the table.

**860.1300 Nature of the Residue - Plants and Livestock**

See the Executive Summary.

**860.1340 Residue Analytical Methods**

**Data Collection:** The carrot and sweet potato field trial studies submitted in support of the current petition were analyzed for residues of glyphosate and AMPA using an adequately validate method derived from the Monsanto method ES-ME-1025-01; both studies included adequate validation data and the method is acceptable for data collections purposes. Briefly, the homogenized samples were extracted with 0.1 N HCl:methylene chloride (3:1; v:v). An aqueous aliquot was taken and purified into concentrated HCl using Fe(III) Chelex resin followed by AG 1-X8 strong anion exchange column chromatography to remove iron. After concentration to dryness, samples were dissolved in the high-performance liquid chromatography (HPLC) mobile phase, filtered through a C18 SPE (solid phase extraction) column, and analyzed using a HPLC. The HPLC system separates glyphosate and AMPA using a post-column reaction system operating specifically for primary amines with glyphosate oxidized to glycine in the presence of sodium hypochlorite while AMPA remained unchanged. Glycine and AMPA were then each coupled with o-phthalaldehyde in the presence of 2-mercaptoethanol. A fluorescence detector was used to detect the resulting products. Based on the lower limit of method validation (LLMV), the limit of quantitation (LOQ) for glyphosate and AMPA is 0.05 ppm (AMPA residues are not expressed in parent equivalents).

**Tolerance Enforcement:** Glyphosate is currently registered for application to a wide variety of crops and HED concludes the currently available tolerance enforcement method is suitable for enforcement of the tolerances recommended here.

**860.1360 FDA Multiresidue Methods (MRMs) Protocols**

The FDA Pestrak database (1990) indicates that recovery of glyphosate under the FDA MRMs is unlikely. Data concerning the behavior of *N*-acetyl-glyphosate under the FDA MRMs has also been previously provided (47133201.der.doc). Using Protocol A, *N*-acetyl-glyphosate was determined not to be naturally fluorescent. Using Protocols B and C, derivatized (methylated) and underivatized *N*-acetyl-glyphosate were tested using the nitrogen-specific Modules DG5 (DB-1 column) and DG17 (DB-17 column) which employ a nitrogen- phosphorus detector (NPD) and the more general Module DG18 (DB-225 column) which employs an electron-capture detector (ECD). *N*-acetyl-glyphosate was not chromatographable using DB-1, DB-17, or DB-225 columns with NPD or ECD; therefore, no testing was performed under Protocols D, E, or F. Because the test substance is not a substituted urea, no testing under Protocol G is required. The results indicate that the MRMs are not suitable for the determination of *N*-acetyl-glyphosate. These data were forwarded to FDA (D349698, T. Bloem, 5-Mar-2008).

**860.1380 Storage Stability** 48720101.der (carrot) and 48720102.der (sweet potato)

In support of the current request, the petitioner submitted carrot and sweet potato field trial data with a maximum interval from collection to analysis of 1040 days for the carrot samples and 780 days for the sweet potato samples. Both the carrot and sweet potato field trial studies included storage stability data which indicated that the glyphosate and AMPA are stable in/on carrot and sweet potato when stored frozen for 779 days and 1041 days, respectively. HED concludes that these data validate the storage interval/conditions for the treated samples submitted in support of the current petition. Table 6 is a summary of the storage intervals and the validated intervals.

<b>Table 6: Summary of Storage Conditions.</b>				
Matrix	Storage Temp (°C)	Analytes	Storage Duration	Interval of Demonstrated Storage Stability
sweet potato	frozen	glyphosate and AMPA	≤780 days (samples analyzed with 7 days of extraction)	779 days; 48720102.der
carrot	frozen	glyphosate and AMPA	≤1040 days (samples analyzed with 14 days of extraction)	1041 days; 48720101.der

**860.1480 Meat, Milk, Poultry, and Eggs**

HED concludes that for the following reasons the proposals associated with the current petition will not have a significant effect on the livestock dietary burdens and the currently-established livestock tolerances remain appropriate: (1) the additional crops included in the updated CG definitions are not considered significant feed commodities; (2) the proposal to extend the harvest-aid application scenario to all oil seed crops (CG20) will not have a significant effect on the livestock dietary burdens as harvest-aid application to cotton, sunflower, and safflower is currently registered; and (3) the increase in the carrot (CC) tolerance to will not have a significant impact on the livestock dietary burdens as a 30-ppm tolerance in/on the grain of several small grains (CC) is currently established.

**860.1500 Crop Field Trials** 48720101.der (carrot) and 48720102.der (sweet potato)

**Revised CG Definitions:** The updated commodity members for the following CGs reflect current HED policy: bulb vegetables CG 3-07; fruiting vegetables CG 8-09; citrus fruit CG 10-09; pome fruit CG 11-09; stone fruit CG 12-10; and berry CG 13-07. Except for CG 13-07, the representative crops for the new and old crop groups are identical and HED concludes that provided the petitioner submits a revised Section B, the tolerances for the old CGs may be translated to the new CGs. HED notes that tolerances are currently established in/on CG 8 at 0.1 ppm and in/on okra at 0.5 ppm; therefore, HED is recommending for a CG 8-10 (except okra) tolerance.

The representative crops for CG 13-07 includes the previous CG 13 representative commodities of any one blackberry or any one raspberry and highbush blueberry as well as elderberry or mulberry, grape, fuzzy kiwifruit, and strawberry. Glyphosate tolerances in/on grape, kiwifruit, and strawberry are currently established at the same level as the current berry CG 13 tolerance (0.2 ppm). In addition, glyphosate tolerances are established in/on the following CG 13-07 commodities at 0.2 ppm: cranberry, juneberry, and lingonberry. However, tolerances are not established in/on the representative crops for the 13-07C subgroup (elderberry or mulberry). Due

to the unrefined nature of the glyphosate dietary risk assessment (tolerance level residues and 100% crop treated) and since a tolerance is established on one of the members of the 13-07C subgroup (juneberry), HED concludes that elderberry or mulberry field trial data are unnecessary. Provided a revised Section B is submitted, HED concludes that the existing berry data and tolerances may be translated to CG 13-07.

**Teff:** Glyphosate is currently registered for application to teff with a teff grain tolerance established at 5.0 ppm. Tolerances in/on teff forage and hay are not established and the petitioner is proposing translating the cereal grain CG 16 (except field corn forage/stover) 100 ppm tolerance to teff forage and hay. The issue was considered by the HED Chemistry Science Advisory Council (ChemSAC) at the 27-July-2011 meeting with the ChemSAC concluding that the proposed translation is acceptable due to the similar morphological, cultural practices, taxonomical characteristics, and application scenarios for teff and the small grains (ChemSAC; min\_542.02-May-2012).

**Carrot and Sweet Potato:** Tolerances for residues of glyphosate in/on root and tuber vegetables (CG1; except sugar beet) are currently established at 0.2 ppm (preemergence application and postemergent application to row middles; wiper application to rutabagas and directed applications to nonbearing ginseng are also permitted). The petitioner is proposing over-the-top wiper application of glyphosate to carrot and sweet potato and submitted field trial data supporting this application scenario. The carrot and sweet potato field trials employed the proposed wiper application scenario and were analyzed for residues of glyphosate and AMPA using an adequately validated methods (storage intervals was also validated). Table 7 is a summary of these data. HED notes that for one of the carrot (FL33) and sweet potato (FL12) field trials, the wiper applications were held too close to the crops and resulted in glyphosate residues of 3.3x and 3.8x, respectively, higher than the next highest residue. Based on the inappropriate application techniques, HED determine that the results from these field trials should be excluded (Table 7 does not include residues from these trials).

With elimination of the field trials mentioned in the previous paragraph, the geographical distribution of the carrot and sweet potato field trials do not conform with the requirements suggested in OPPTS 860.1500. For sweet potato, an additional trial in the North American Free Trade Agreement (NAFTA) zone 3 is needed, and for carrot, additional trials in the NAFTA zones 3 (n=1), 10 (n=1), and 11 (n=1) are needed. Due to the unrefined nature of the glyphosate dietary risk assessment (tolerance level residues and 100% crop treated) and since the available carrot and sweet potato trials were conducted in the NAFTA zones which correspond to a significant proportion of the U.S. production for these crops, HED concludes that additional field trial data are unnecessary. Based on the submitted data and the OECD tolerance calculation procedure, the following tolerances for residues of only glyphosate are appropriate (see attachment 3): carrot - 5.0 ppm and sweet potato - 3.0 ppm. With the establishment of these tolerances, the currently established "vegetable, root and tuber, group 1, except sugar beet" tolerance should be removed and the following tolerance established (residues of only glyphosate): vegetable, root and tuber, group 1, except sugar beet, carrot, and sweet potato - 0.2 ppm. A revised Section F is requested.

**Oilseed CG 20:** The petitioner is proposing the establishment of an oilseed CG 20 tolerance (40 ppm; glyphosate only) and is proposing harvest-aid application to all CG 20 crops. The representative crops for CG 20 are canola (subgroup 20A), sunflower (subgroup 20B), and cotton (subgroup 20C) with glyphosate tolerances established in/on the seeds of these crops as follows: canola seed - 20 ppm (combined glyphosate and *N*-acetyl-glyphosate), sunflower/safflower seed - 85 ppm (glyphosate only), and cotton seed - 40 ppm (glyphosate only). Tolerances are also established in/on several other CG 20 crops as follows: borage - 0.1 ppm, crambe - 0.1 ppm, flax - 4.0 ppm, meadowfoam - 0.1 ppm, mustard - 0.1 ppm, safflower - 85 ppm, and sesame - 0.1 ppm. These tolerances reflect preemergent and postemergent (row middles using shielded sprayers or wiper equipment) application for all as well as harvest-aid application for sunflower (0.77 lb ae/acre), safflower (2.25 lb ae/acre), and cotton (1.55 lb ae/acre) and over-the-top application to canola and cotton (glyphosate-tolerant varieties).

Based on the discussion provided in the paragraphs below and provided the petitioner submits a revised Section B, HED concludes that the following tolerance is appropriate (revised Section F is requested): oilseed, group 20, except canola, - 40 ppm (residues of glyphosate only; 180.364(a)(1)). The currently-established 20-ppm canola seed tolerance for the combined residues of glyphosate and *N*-acetyl-glyphosate should remain so as to maintain harmonization of the tolerance value with Canada and Codex and to monitor for *N*-acetyl-glyphosate which is a major residue in some glyphosate-tolerant canola varieties. The currently-established tolerances for the various member of CG 20, excluding the canola tolerance, should be deleted.

Cotton - subgroup 20C: Several cotton residue studies have been previously submitted which included a harvest-aid application and yielded glyphosate residues in/on cotton seed of 0.16-12 ppm (D214929 and D214931, G. Kramer, 31-Jul-1995; D332880, J. Tomerlin, 30-Apr-2007; D348927, T. Bloem, 2-Sep-2008). Based on these data and in order to harmonize with Codex, a cotton seed tolerance of 40 ppm for residues of glyphosate is currently established. Therefore, the HED-recommended 40 ppm CG 20 (except canola) tolerance is appropriate for the 20C subgroup.

Sunflower and Safflower - subgroup 20B: Sunflower and safflower residue data which included a harvest-aid application have been previously submitted (D321667, J. Tomerlin, 6-May-2006). The currently-established sunflower seed and safflower seed glyphosate tolerances of 85 ppm (residues of glyphosate only) are based these data and the NAFTA tolerance calculation procedure. Although both sunflower and safflower data were submitted, the tolerances for both are based on the sunflower data due to inadequate geographical distribution for safflower (residues were higher in sunflower). Using these data and the OECD tolerance calculation procedure, sunflower seed and safflower seed tolerances of 30 ppm and 6 ppm, respectively, are calculated (see attachment 3). The petitioner indicated that a 40 ppm CG 20 tolerance is necessary to maintain harmonization of the cotton seed tolerance with Codex (see above). Based on this consideration and the available residue data, the HED-recommended 40 ppm CG 20 (except canola) tolerance is appropriate for the 20B subgroup.

Canola - subgroup 20A: HED has previously reviewed residue data conducted with genetically-modified canola which included a harvest-aid application at 0.5x the proposed rate (D394964, T. Bloem, 15-Nov-2011). The canola variety employed in these field trials (DuPont™ Optimum® GLY Canola) was genetically modified to express the *gat4621* gene which confers tolerance to

glyphosate via metabolism of glyphosate to the non-herbicidal *N*-acetyl-glyphosate. These harvest-aid trials were conducted in Canada and were submitted along with U.S. trials which did not include a harvest-aid treatment. The data were submitted to demonstrate the magnitude of glyphosate residues in/on DuPont™ Optimum® GLY Canola with the differing application scenarios a reflection of the registered application scenarios in each country. Combined residues of glyphosate and *N*-acetyl glyphosate in/on canola seed which did and did not receive the harvest-aid treatment were 0.54-15 ppm and <0.11-2.0 ppm, respectively. As a result of the introduction of this new variety of canola, HED recommended that the tolerance expression change from residues of glyphosate to the combined residues of glyphosate and *N*-acetyl glyphosate (tolerance value stayed the same; 20 ppm). HED has also previously reviewed European canola data which employed only a harvest aid application at 0.8x the proposed rate and resulted in glyphosate residues in/on the seed of 0.2-6.3 ppm (D178843, D. Davis, 29-Sep-1993).

Due to the introduction of DuPont™ Optimum® GLY Canola and the resulting change in the tolerance expression and to maintain a harmonized canola seed tolerance value with Canada and Codex, HED concludes that the currently-established canola seed tolerance should be maintained. As a result, the oilseed crop group tolerance should exclude canola. Based on the European harvest-aid data, the 20-ppm canola seed tolerance is appropriate for harvest-aid application to non-genetically modified canola and the 40-ppm CG 20 (except canola) tolerance is acceptable for the remaining crops in the 20A subgroup.

**Table 7. Summary of Residue Data.**

Commodity	Total App. Rate <sup>1</sup>	PHI (days)	Analyte	Residue Levels (ppm) <sup>2</sup>							
				n	Sample Min.	Sample Max.	LAFT <sup>3</sup>	HAFT <sup>3</sup>	Median	Mean	Std. Dev.
sweet potato tuber <sup>5</sup>	preplant - 1.09-1.15 lb ae/acre; wiper - 33.0% v/v (five times)	6-8	glyphosate	7	<0.05	1.84	0.05	1.36	0.41	0.49	0.44
			AMPA <sup>4</sup>	7	<0.05	<0.05	0.05	0.05	0.05	0.05	--
carrot root <sup>5</sup>	preplant - 1.11-1.15 lb ae/acre; wiper - 33.0% v/v (twice)	6-8	glyphosate	5	<0.05	4.33	0.05	2.62	0.30	0.77	1.08
			AMPA <sup>4</sup>	5	<0.05	0.07	0.05	0.06	0.05	0.05	0.004

<sup>1</sup> Sweet potato - preplant burn-down application (1.09-1.15 lb ae/acre; 6-8 days prior to planting) and five over-the-top wiper applications (61-65, 48-50, 33-36, 19-22, and 6-8 days before harvest; 33% solution of the formulated product). Carrot - preplant burn-down application (1.11-1.15 lb ae/acre; 6-7 days prior to planting) and two over-the-top wiper applications (59-69 days before harvest and 6-8 days before harvest; 33% solution of the formulated product). All applications to the sweet potato and carrot plots were made with Roundup WeatherMAX®.

<sup>2</sup> Except for sample min/max, values reflect per trial averages; n = no. of field trials. The calculations were performed assuming LOQ residues for residues <LOQ.

<sup>3</sup> LAFT = lowest-average field trial; HAFT = highest-average field trial.

<sup>4</sup> AMPA residues are not expressed in parent equivalents.

<sup>5</sup> The residue summary does not include carrot data from the FL33 trial or sweet potato data from the FL12 trial.

**860.1520 Processed Food and Feed**

For the purposes of the current action, processing data are necessary for the following crops: canola, sunflower, safflower, and cotton. Processing data have been previously submitted for these crops and these data indicated that tolerances in/on the processed commodities were unnecessary (canola - D394964, T. Bloem, 15-Nov-2011 and D221254, T. Bloem, 24-Aug-1998; sunflower and safflower - D321667, J. Tomerlin, 6-May-2006; cotton - D214929 and D214931, G. Kramer, 31-Jul-1995). Based on these data and the tolerances recommended here, HED reaffirms the conclusion that tolerances in/on the processed commodities associated with the current petition are unnecessary. HED notes that some concentration was noted in canola meal and safflower meal but tolerances in/on these commodities are unnecessary based on the raw agricultural commodity tolerance and the processing factors.

**860.1850 & 860.1900 Confined and Field Accumulation in Rotational Crops**

HED previously concluded that a 30-day PBI was appropriate for all non-labeled crops (D200041, G. Kramer, 12-May-1994). Provided a revised Section B is submitted specifying a 30-day PBI for all non-labeled crops following application to 13-07G crops (excluding cranberry), the proposed labels will conform with this requirement.

**860.1550 Proposed Tolerances**

Based on the available data, HED concludes that the tolerance listed in Table 8, for residues of glyphosate *per se*, are appropriate (40 CFR §180.364(a)(1)). With the establishment of the tolerances listed in Table 8, the following tolerances should be deleted: vegetables, root and tuber, crop group 1, except sugar beet; vegetable, bulb, group 3; vegetable, fruiting, group 8; fruit, citrus, group 10; fruit, pome, group 11; berry group 13; borage, seed; cotton, undelinted seed; crambe, seed; flax, meal; flax, seed; jojoba seed; lesquerella, seed; meadowfoam, seed; mustard seed; rapeseed, seed; safflower, seed; sesame, seed; sunflower, seed; cranberry; grape; junberry; kiwifruit; lingonberry; salal; and strawberry.

There are no Canadian, Codex, or Mexican maximum residue limits for residues of glyphosate in/on carrot or sweet potato or for CGs 1, 3-07, 8-10, 10-10, 11-10, or 13-07; therefore, harmonization is not an issue for these crops or CGs. There are Codex and Canadian maximum residue limits for the following oilseed crops: Codex (glyphosate only) - cotton seed at 40 ppm, sunflower seed at 7 ppm, and canola seed at 20 ppm; Canada (combined residues of glyphosate and AMPA) - canola seed at 10 ppm and flax at 3 ppm.

HED recently consulted the Canadian Pesticide management Regulatory Agency (PMRA) concerning the canola seed tolerance with the PMRA indicating that they are willing to increase the canola seed tolerance to 20 ppm (D394964, T. Bloem, 15-Nov-2011). Therefore, the HED-recommended tolerance value for canola seed will be harmonized with Canada and Codex; however, the tolerance expressions are different. Based on the residue data and use pattern for the remaining oilseed crops, HED concludes that the HED-recommended 40-ppm tolerance for CG 20 (except canola) is appropriate; it is noted that with the establishment of this tolerance the U.S. and Codex cottonseed tolerance will be harmonized. Based on the oilseed residue data, harmonization with the Canadian flax and Codex sunflower seed tolerances is not possible.

**Table 8: Tolerance Summary.**

Commodity	Proposed Tolerance (ppm)	HED-Recommended Tolerance (ppm)	Comments
vegetables, root and tuber, group 1, except sugar beet	6	not recommended	Based on the magnitude of the residue following wiper application, HED concludes that separate carrot and sweet potato tolerances should be established.
vegetables, root and tuber, group 1, except carrot, sweet potato, and sugar beet	--	0.20	
carrot	--	5.0	
sweet potato	--	3.0	
oilseeds, group 20	40	not recommended	In order to maintain harmonization with Canada and Codex and due to the introduction of DuPont™ Optimum® GLY Canola and the resulting change in the canola seed tolerance expression, HED concludes that maintaining the current canola seed tolerance is appropriate.
oilseeds, group 20, except canola	--	40	
vegetable, bulb, group 3-07	0.2	0.20	HED concludes that the tolerance values should be revised to reflect HED policy concerning significant figures and/or the commodity definition should change.
vegetable, fruiting, group 8-10 <sup>1</sup>	0.1	not recommended	
vegetable, fruiting, group 8-10 (except okra) <sup>1</sup>	--	0.10	
fruit, citrus, group 10-10	0.5	0.50	
fruit, pome, group 11-10	0.2	0.20	
berry and small fruit, group 13-07	0.2	0.20	
teff, forage	100	100	The proposed tolerances are adequate.
teff, hay	100	100	

<sup>1</sup> Tolerance are currently established in/on CG 8 at 0.1 ppm and in/on okra at 0.5 ppm; note that okra was not included in CG 8 but is included in CG 8-10.

RDI: RAB1 Chemists (24-Oct-2012)

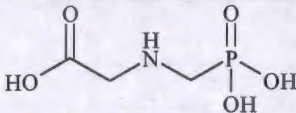
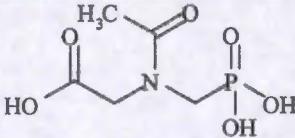
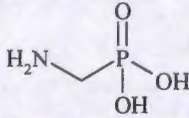
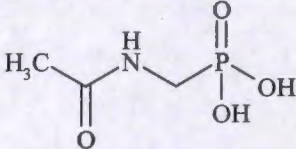
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Attachment 1 - Chemical Structures

Attachment 2: International Residue Limits

Attachment 3: OECD Tolerance Calculation Spreadsheet

## Attachment 1 - Chemical Structures

Compound	Structure
Glyphosate <i>N</i> -(phosphonomethyl)glycine	
<i>N</i> -acetyl-glyphosate <i>N</i> -acetyl- <i>N</i> -(phosphonomethyl)glycine	
AMPA (aminomethyl)phosphonic acid	
<i>N</i> -acetyl-AMPA [(acetylamino)methyl]phosphonic acid	

## Attachment 2: International Residue Limits:

Summary of US and International Tolerances and Maximum Residue Limits				
Residue Definition				
US	Canada	Mexico <sup>2</sup>	Codex <sup>3</sup>	
all except canola seed - 40 CFR 180.364(a)(1): glyphosate (N- (phosphonomethyl)glycine)	All food crops except dry soybeans and field corn: N-(phosphonomethyl)glycine, including the metabolite aminomethylphosphonic acid	--	glyphosate. (except soya bean and maize) The residue is not fat-soluble.	
canola seed - 40 CFR 180.364(a)(2): glyphosate (N-(phosphonomethyl)glycine) and N-acetyl-glyphosate (N-acetyl- N- (phosphonomethyl)glycine) calculated in parent equivalents				
Tolerance/Maximum Residue Limit (ppm)				
Commodity <sup>1</sup>	US	Canada	Mexico <sup>2</sup>	Codex <sup>3</sup>
vegetables, root and tuber, group 1, except carrot, sweet potato, and sugar beet	0.2	--	--	--
carrot	5.0	--	--	--
sweet potato	3.0	--	--	--
oilseeds, group 20, except canola	40	3 flax	--	40 cotton seeds 7 sunflower seed
canola seed	20	10 rapeseeds (canola)		20 rape seed
vegetable, bulb, group 3-07	0.2	--	--	--
vegetable, fruiting, group 8-10	0.1	--	--	--
fruit, citrus, group 10-10	0.5	--	--	--
fruit, pome, group 11-10	0.2	--	--	--
berry and small fruit, group 13-07	0.2	--	--	--
Completed: M. Negussie: 05/09/2012				

<sup>1</sup> Includes only commodities of interest for this action. Tolerance values should be the HED recommendations and not those proposed by the applicant.

<sup>2</sup> Mexico adopts US tolerances and/or Codex MRLs for its export purposes.

<sup>3</sup> \* = absent at the limit of quantitation; Po = postharvest treatment, such as treatment of stored grains. PoP = processed postharvest treated commodity, such as processing of treated stored wheat. (fat) = to be measured on the fat portion of the sample. MRLs indicated as proposed have not been finalized by the CCPR and the CAC.

## Attachment 3: OECD Tolerance Calculation Spreadsheet

Compound	glyphosate	glyphosate	glyphosate	glyphosate
Crop	carrot (48720101)	sweet potato (48720102)	sunflower (D321667)	safflower (D321667)
Region / Country	USA	USA	USA	USA
GAP				
Total number of data (n)	5	7	8	3
Percentage of censored data	0%	14%	0%	33%
Number of non-censored data	5	6	8	2
Lowest residue	0.050	0.050	0.110	1.200
Highest residue	2.615	1.355	18.500	2.800
Median residue	0.300	0.410	2.750	1.600
Mean	0.767	0.486	4.606	1.867
Standard deviation (SD)	1.078	0.443	6.068	0.833
Correction factor for censoring (CF)	1.000	0.905	1.000	0.778
Proposed MRL estimate				
- Highest residue	2.615	1.355	18.500	2.800
- Mean + 4 SD	5.079	2.258	28.877	5.197
- CF x 3 Mean	2.301	1.318	13.817	4.356
Unrounded MRL	5.079	2.258	28.877	5.197
Rounded MRL	5	3	30	6
	High uncertainty of MRL estimate due to small dataset.	High uncertainty of MRL estimate due to small dataset.		High uncertainty of MRL estimate due to small dataset.
	Residues (mg/kg)	Residues (mg/kg)	Residues (mg/kg)	Residues (mg/kg)
	0.060	1.355	0.110	1.200
	0.810	0.050	6.350	2.800
	0.300	0.068	5.350	1.600
	0.050	0.410	3.250	
	2.615	0.605	18.500	
		0.590	2.250	
		0.321	0.690	
			0.345	